UINTAH AND OURAY RESERVATION

Introduction

The Uintah and Ouray Indian Reservation is located in the Uinta Basin, in northeast Utah (FIGURES UO-1 and UO-2). The terrain is High Mountain desert in the central part of the basin, which is surrounded by mountain ranges on the edge of the basin. Elevation varies from approximately 5,600 feet to over 11,000 feet above sea level. The area's main transportation conduit is U.S. Highway 40, which leads east to Salt Lake City, Utah, and west to Denver, Colorado. The basin covers approximately 11,500 square miles, and Ute Indian Tribe jurisdiction comprises just over 4 million acres of this area, reaching from the Utah-Colorado border west to the Wasatch Mountain range.

Mineral Ownership

The Uintah and Ouray Indian Reservation is a checkerboard ownership reservation containing Ute Indian Tribe, Ute Indian Allotted, Ute Indian Tribe and Ute Distribution Corporation Jointly Managed Indian Trust minerals, along with fee (privately owned) and federal minerals. Indian properties cover approximately 1.2 million surface-owned acres, and 400,000 mineral-owned acres within the 4 million-acre jurisdictional boundary. Ute Indian Allottees, the Ute Indian Tribe, and the Ute Distribution Corporation own both surface and mineral properties in joint management.

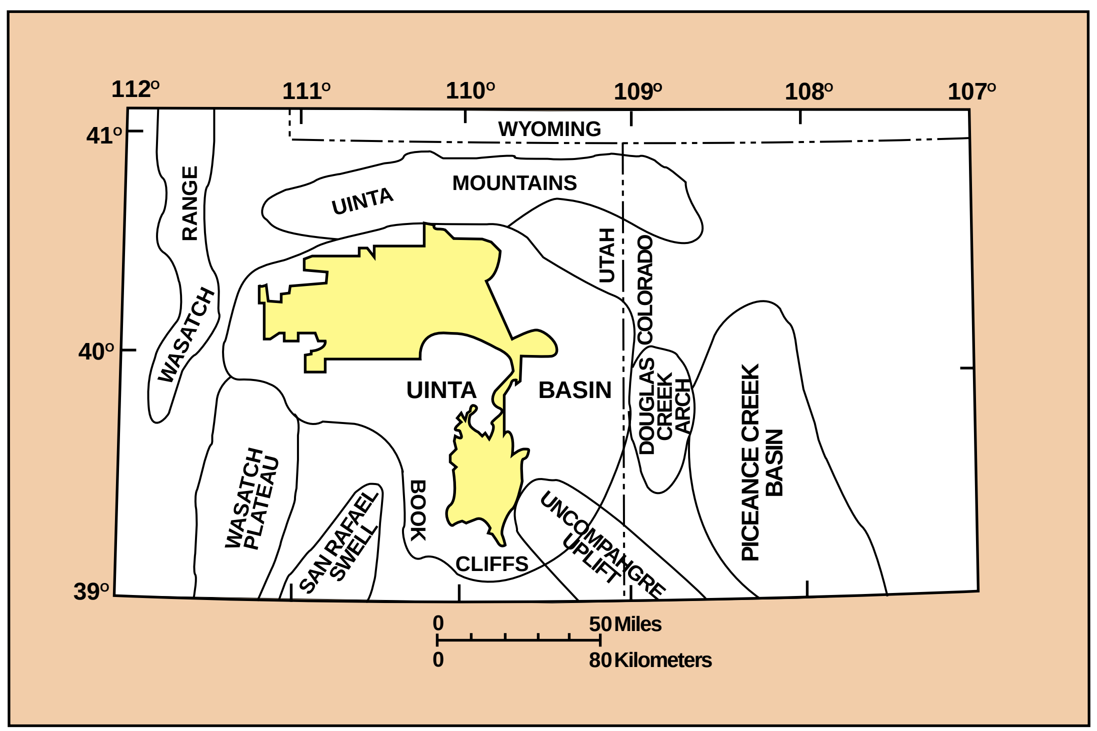


Figure UO-1. Location of Uinta Basin and surrounding structural and physiographic features. Yellow area shows approximate boundary of Uintah and Ouray Indian Reservation (modified after Cashion, 1992).

Currently, the Ute Tribe, Ute Allottees, and the Ute Distribution Corporation in joint management hold 102,000 acres under lease, and more than 490 wells in production. The Utah Oil, Gas, and Mining Board conduct conservation spacing in cooperation with the Ute Tribe. Spacing rules for the Altamont-Bluebell field are set at a multi-well level allowing two wells per section, while undesignated field spacing is 40 acres for oil and 640 acres for gas. Some variations or exceptions exist by special ruling and order (Anderson, 1995).

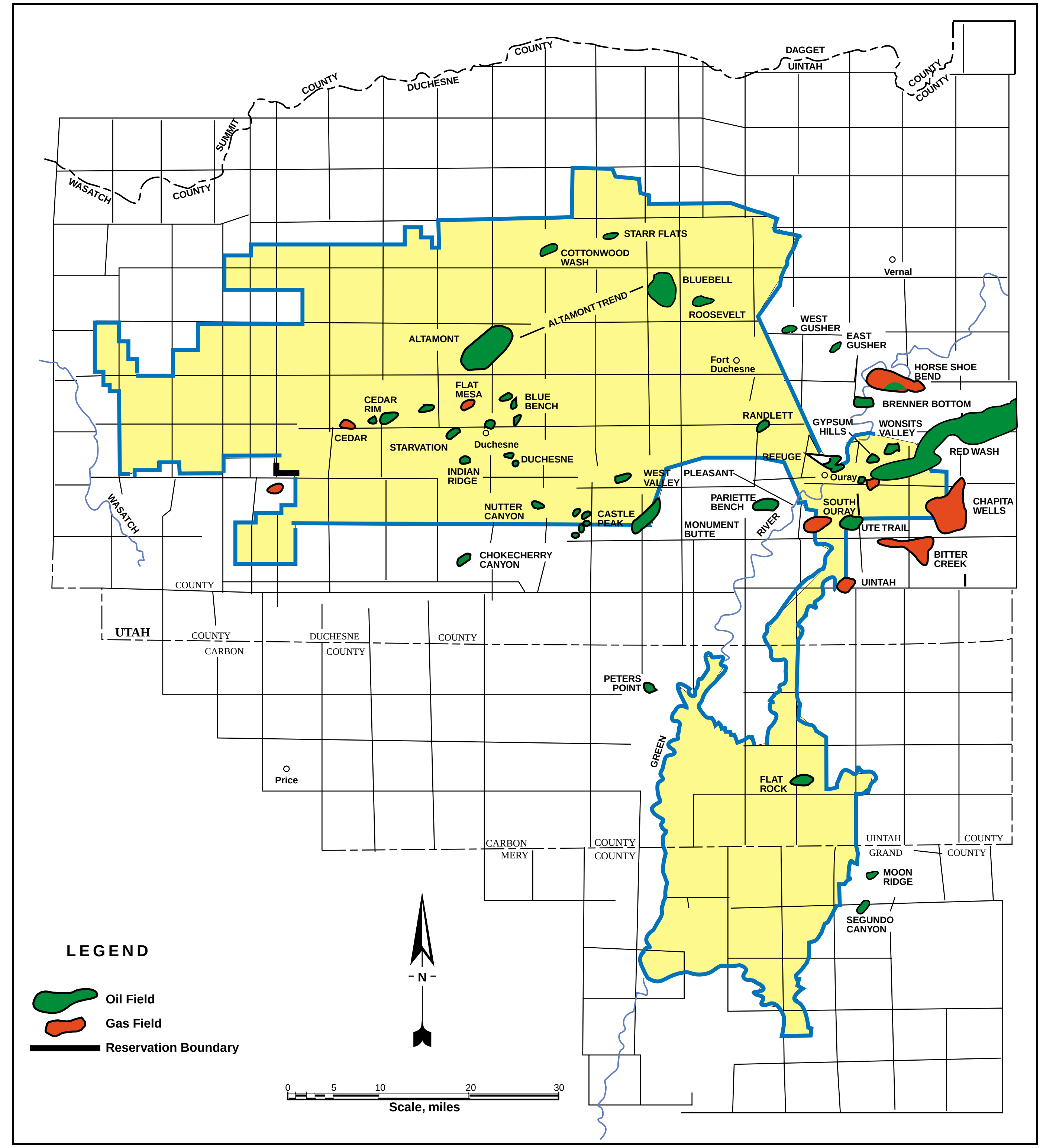


Figure UO-2. Index map showing the Uintah and Ouray Indian Reservation in yellow (modified after Anonymous, 1995).

Uintah and Ouray Reservation Petroleum Exploration and Development

The Uinta Basin is a rich source of many energy-producing minerals. The greatest portion of the energy resources is hydrocarbons in the form of coal, oil, gas, oil shale, and bituminous sandstone and limestone.

Resources contained within the Uintah and Ouray Reservation include conventional and unconventional hydrocarbon deposits of oil and gas, oil shale, and tar sands in major quantity; coal, uranium, silver, copper, gold, gypsum, and phosphate are also present in minor to mid-economic quantities.

Cretaceous and older rocks contain many productive oil and gas zones. However, the major portion of the energy production from the Uinta Basin is from Tertiary rocks, and the distribution of the hydrocarbons and minerals is directly related to their depositional environment.

Uinta Basin production of oil and gas began in the late 1940's, with major development commencing in the late 1960's and expanding in the late 1970's and early 1980's. Over 300 million barrels of oil (MMBO) have been produced from the Greater Altamont-Bluebell field alone. Conventional oil and gas deposits have been extensively explored and developed. The Green River and Wasatch Formations contain the bulk of the producing zones, with depth to these zones ranging from 6,000 to 18,000 feet. This has resulted in the development of the Greater Altamont-Bluebell oil field, and numerous undesignated smaller fields (FIGURES UO-2, UO-6).

The oil produced is high in paraffin content (pour point = 120 degrees F), making it an excellent gasoline refining feedstock. It is extremely rich with associated natural gas, with values falling between 900 and 1700 British thermal units (Btu). Only one natural gas field has been developed, and it is located east and south of the Green and White Rivers. It is bordered by the Natural Buttes Gas Field Unit, which covers 76,000 acres.

Total Ute Indian oil production approximates 1,250 barrels per day, a level that has held for the last 10 years. New well development and workover activity has been sufficient to offset the normal decline of the many oil and gas fields within the basin and the reservation area (Anderson, 1995).

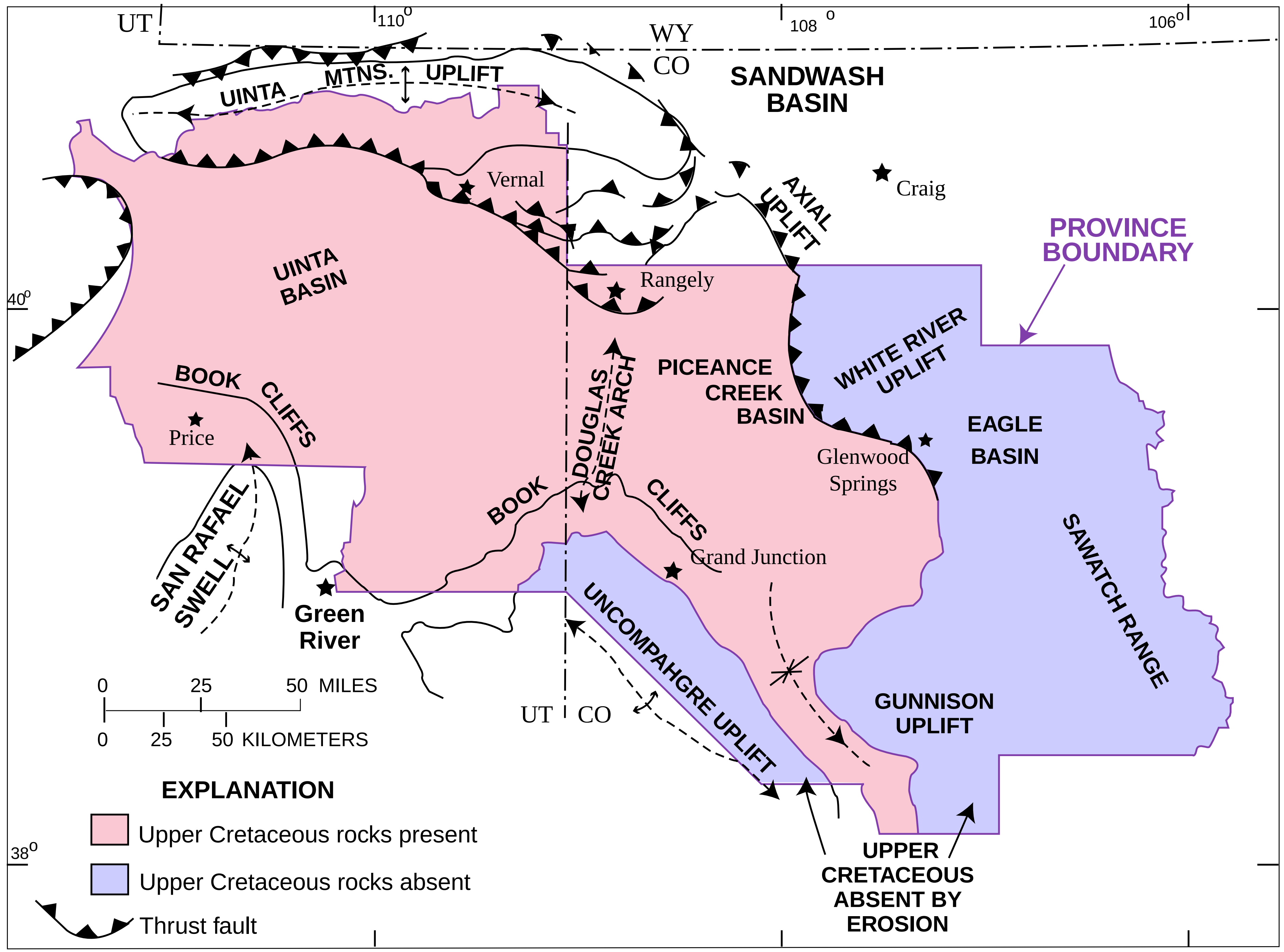
Geology of the Uinta Basin

The Uinta Basin is a major sedimentary basin in the western-central Rocky Mountain province. It is bounded by the Uinta Mountain Uplift on the north and by the Wasatch Mountain Uplift and the eastern faulted margin of the Wasatch Plateau on the west. On the southwest and south, the San Rafael Swell and the Uncompahgre Uplift border the basin (FIGURES UO-2 and UO-3). The southern basin edge is generally considered to be the Book and Roan Cliffs, escarpments of Upper Cretaceous and Lower Tertiary formations which dip northwest, north, and northeast into the basin. The northwest-southeast trending salt folds of the northern Paradox Basin plunge beneath the Book Cliffs in the southernmost part of the basin, and the two downwarps merge imperceptibly in this area. On the east, the Uinta Basin is separated from the Piceance Basin of northwest Colorado by the Douglas Creek Arch, which parallels the Utah-Colorado border (FIGURE UO-3).

The basin is quite asymmetric. Beds on the north flank dip 10 to 35 degrees south, whereas beds on the south flank dip only 4 to 6 degrees north (Chidsey, 1993). The north flank is highly complex, with major faulting, steep to overturned beds, and multiple unconformities that allow youngest Eocene rocks to lie unconformably on top of Precambrian rocks. The basin axis is close to the mountain flank and moves northward with depth.

The Uinta Basin formed in Late Cretaceous and Paleocene time when, in response to rapid uplift and formation of the Uinta Mountains, the dominant north-south tectonic and sedimentation patterns of Cretaceous time shifted to west-east. The Uintas impose a dominant west-east trend through most of the basin; however, structures in the southeast portion have a strong northwest grain, reflecting the older buried Uncompahgre and Paradox trends.

Figure UO-3. Location and structural element map of the Uinta and Piceance Basin Provinces (modified after Gautier et al., 1995).



The Uinta Basin is filled with 30,000 to 32,000 feet of sediment in its northern and deepest portion (Figs. UO-4 and UO-5). Although the majority of the rocks exposed on the reservation are of Tertiary age, some pre-Tertiary age rocks are exposed on the northern and northwestern boundaries. Percentages of basin strata are subdivided as follows:

Tertiary (Eocene - Paleocene) -	55%
Upper Cretaceous -	25%
Triassic - Lower Cretaceous -	10%
Paleozoic -	10%

GEOLOGIC TIME		GROUP AND FORMATION	CHARACTER OF BEDS	THICKNESS (ft.) EAST	THICKNESS (ft.) WEST
Quaternary		Alluvium	Alluvium, gravel surfaces, talus deposits, and other windblown deposits		
		Pleistocene Glacial Deposits	Glacial drift, alluvium, and terrace deposits	0-70	0-70
Tertiary	Miocene	Bishop Conglomerate	Conglomerate, boulders 1 to 6 feet in diameter, sand and gravel	0-500	0-500
	Oligocene	Duchesne River Formation	Varicolored shale, sandstone, and conglomerate	1370	1500
	Eocene	Uinta Formation	Shale with sandstone interbeds	700-1650	1800-5400
		Green River Formation	Green to white shale, sandstone, oil shale in middle of formation	1800-2400	0-5000
		Wasatch Formation	Varicolored sandstone, shale, limestone	0-5000	—
Paleocene deposits absent due to unconformity					
Cretaceous		Currant Creek Formation	Conglomerate, sandstone, and varicolored shale	—	0-4800
		North Horn Formation	Varicolored shale with sandstone interbeds	0-400	0-200
Upper Cretaceous		Mesaverde Group	Upper section - Brackish-water sandstone, sandy shale, carbonaceous shale, and coal	0-3000	1000-2200
			Lower section - Marine sandstone	0-500	300-1000
		Mancos Shale (including Frontier Sandstone Member)	Black marine shale, thick massive sandstone, shaly sandstone	5000-6000	800-3500
		Dakota Sandstone	Cross-bedded tan sandstone	30-50	30-50
Jurassic		Morrison Formation	Varicolored shale with sandstone interbeds	780-800	780-800
Triassic		Chinle Formation	Shale with minor sandstone and conglomerate	230	300-380
		Moenkopi Formation	Shale, sandstone, siltstone, and limestone	2300	800
Permian		Park City Formation	Argillaceous, sandy limestone	80-500	80-500
Pennsylvanian		Weber Sandstone	Massive sandstone	1000-1500	1000-1500
		Morgan Formation	Varicolored shale and limestone with sandstone	300-800	300-800
Mississippian	Upper	Manning Canyon Shale Humbug Formation Great Blue Formation Molas Formation Doughnut Formation	Interbedded shale, limestone, and sandstone	0-900	0-900
	Lower	Redwall Formation Leadville Formation Deseret Formation Madison Formation	Massive dolomite and limestone	0-1100	0-1100
Devonian		—	Sandstone, shale, carbonate	1000	2000
No identifiable Silurian or Ordovician deposits					
Cambrian		Tintic Quartzite or Lodore Formation	Sandstone, shale, and carbonate	0-2000	0-2000
Precambrian		Uinta Mountain Group	Quartzite with shale and conglomerate	12,000-20,000	
		Uncompahgre Suite	Schist, gneiss, and granite		

Figure UO-4. General stratigraphic column of the Uinta Basin (modified after Anonymous, 1995).

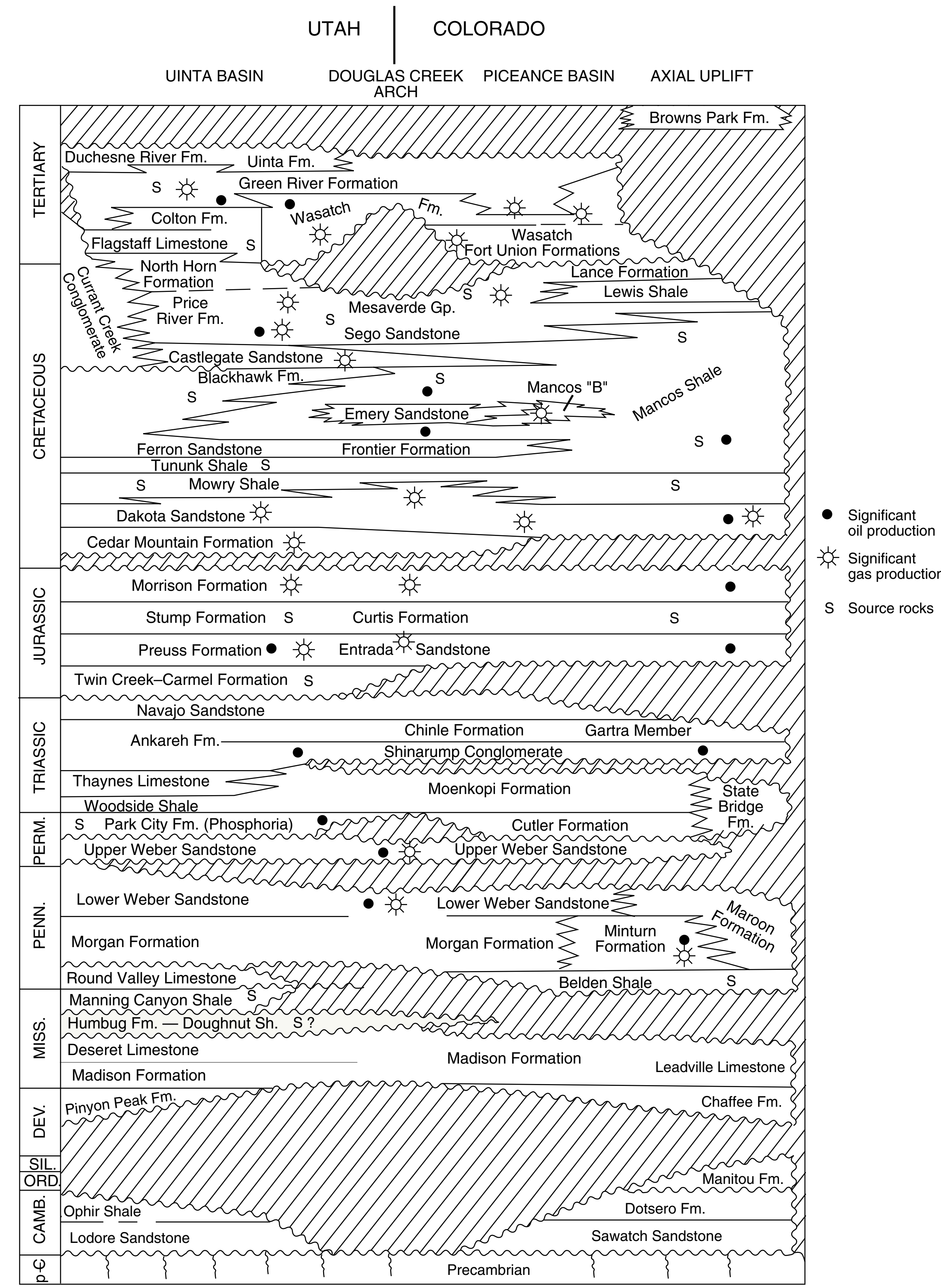


Figure UO-5. Diagram showing general correlation of rock units from the Uinta Basin, Utah, to the Axial Uplift, Colorado, and significant producing and source horizons (modified after Spencer and Wilson, 1988)

During Eocene time (38-50 million years ago) large amounts of sediment from adjacent higher areas were deposited in lacustrine and fluvial environments in the basin. These sediments, assigned to the Wasatch, Green River, and Uinta Formations, are perhaps more than 15,000 feet thick in the center of the basin, and contain important mineral resources (FIGURE UO-6).

Much of the area now occupied by the Uinta Basin was covered by a large lake during Eocene time. Lacustrine marlstone, oil shale, limestone, siltstone, and sandstone of the Green River Formation were deposited in the lake. During the lake's expansionary periods, fluvial sediments were deposited which are now beneath and peripheral to the lacustrine sediments. These fluvial deposits form the shale, sandstone, and conglomerate of the Wasatch Formation. As the lake receded, fluvial sediments were deposited on its periphery, and eventually covered the entire area formerly occupied by the lake. These deposits comprise the Uinta Formation (Anderson,1995).

Uinta Formation

The Late Eocene Uinta Formation consists of fluvial deposits that overlie the Green River Formation from the last phase of Lake Uinta. Later, the lake filled up with volcaniclastic material, followed by abundant bedded evaporites. Depths to the top of the formation range from 2,566 feet to 3,678 feet, with the average being 3,554 feet.

Most of the production is from the Lower Uinta, which is a transitional unit between the Green River Formation and the fluvial Upper Uinta. The Lower Uinta is 350 to 450 feet thick in the Horseshoe Bend field, a reservoir that has produced over 15 BCF of non-associated gas and 5,000 barrels of condensate. This is the only reservoir that has produced at least 5 BCFG from the Uinta Formation, although minor production exists elsewhere in the basin (FIGURES UO-6 and UO-7).

The primary drive mechanism is gas expansion and gravity, and the trap is an updip stratigraphic pinch-out. The average monthly gas production has been increasing since 1981 due to development drilling and new wells that were drilled in the early to mid-1980s.

The Uinta Formation is rarely a primary drilling target, but it is a shallow, low cost target with potential for new discoveries (Morgan, 1993a).

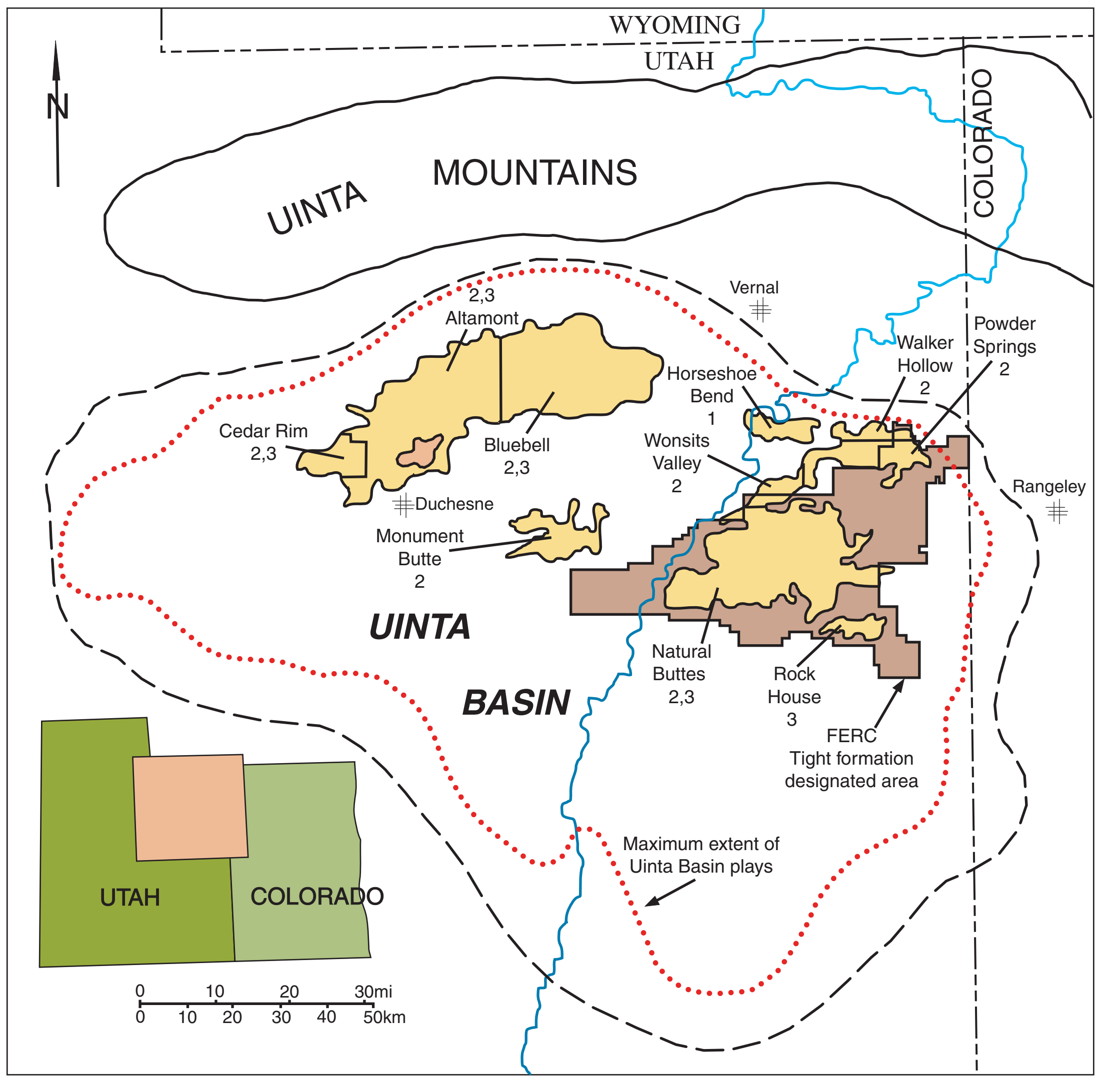


Figure UO-6. The Uinta Basin with the maximum extent of play areas based on production and hydrocarbon shows. Reservoirs are labeled: 1, Uinta Formation; 2, Green River Formation; and 3, Wasatch Formation. Note outline for Federal Energy Regulatory Commission (FERC) tight formation designated area (Wasatch/Mesaverde) in the east part of the basin. Hachured line indicates approximate limits of Tertiary units in the Uinta Basin (modified after Chidsey, 1993a).

Green River Formation

The Eocene-Paleocene Green River Formation is 2,000 to over 8,000 feet thick. It accumulated in and around ancestral Lake Flagstaff and Lake Uinta, along with the alluvial-fluvial deposits of the Wasatch Formation. The Green River Formation was deposited as thick, regionally extensive stratigraphic sequences in marginal and open lacustrine environments. Depths to the top of the formation range from 2,315 to 7,456 feet, and most wells produce from zones 3-4,000 feet below the top.

The majority of the producing zones are channel sandstones about 10 to 30 feet thick, but some reservoirs produce from carbonate grainstones 10 to 20 feet in thickness (FIGURE UO-8). The porosity and permeability of these zones can be either reduced or enhanced by diagenetic effects. The average porosity of Green River reservoirs ranges from 5 to 20 percent, and the permeability ranges from 0.1 to 42 millidarcies (mD).

The source rocks for oil and associated gas found in the Green River Formation are interbedded organic-rich carbonate mudstones located at depths of 8,500 to 12,500 feet in the north-central part of the basin. Hydrocarbons, which were generated in deep overpressured zones, migrated laterally along fracture systems to shallow reservoirs located on the south and east flanks of the basin.

There are more than 60 known reservoirs producing from the Green River Formation, 9 of which have each produced more than 5 BCFG (FIGURE UO-6). The Roosevelt reservoir was the first to produce gas from this formation in 1949. Monthly production peaked in the mid-1970s, and decreased to a low in 1982. It has been increasing since then due to in-fill drilling programs in several reservoirs (Chidsey, 1993b).

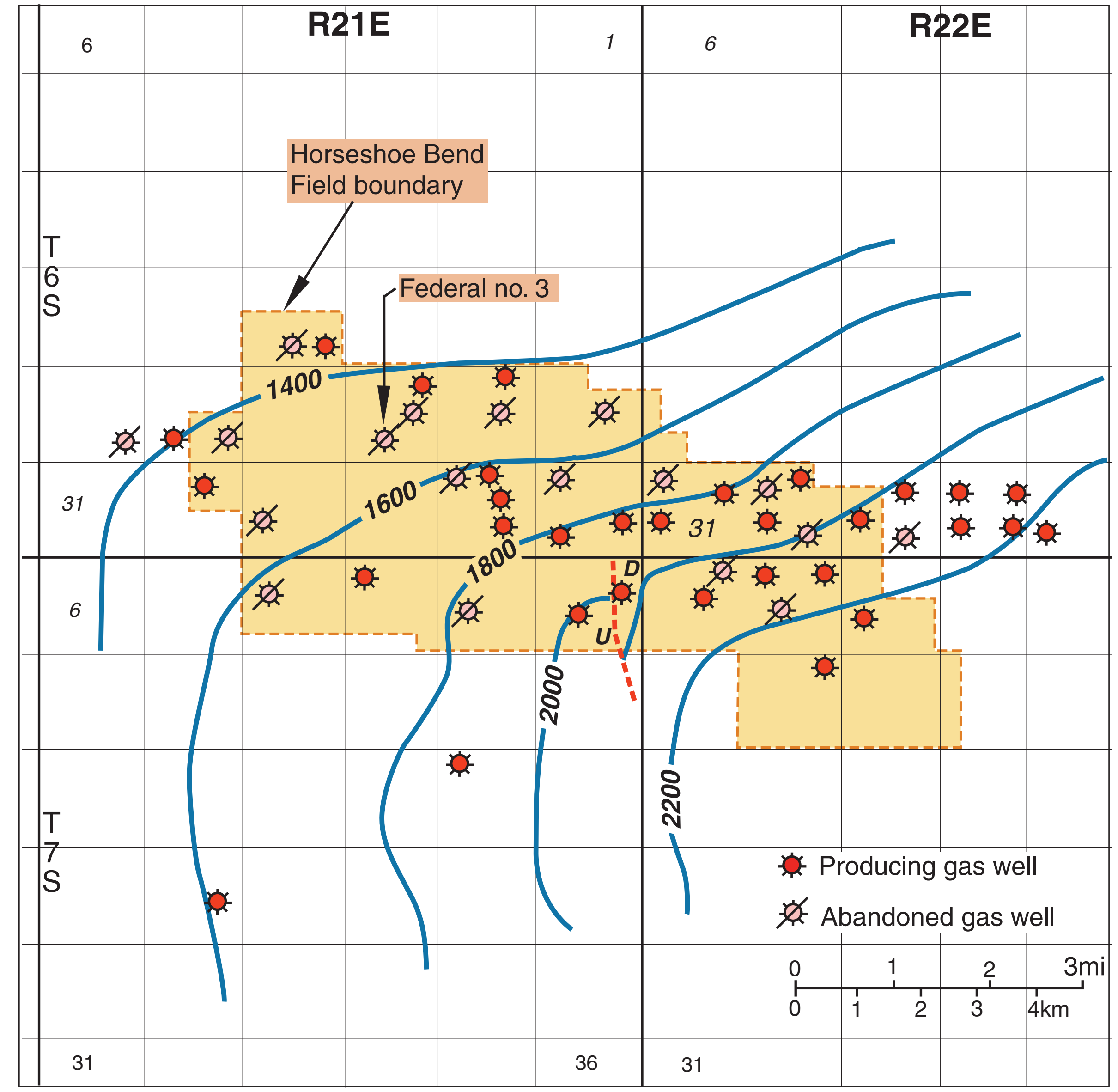


Figure UO-7. Structure contour map of the Horseshoe Bend area. Datum is the top of Unit A, Uinta Formation with a contour interval of 200 ft. Only wells that have produced from the Uinta Formation are shown (modified after Morgan, 1993a).

Wasatch Formation

The Eocene-Paleocene Wasatch Formation is up to 3,000 feet thick. It accumulated in and around ancestral Lake Flagstaff and Lake Uinta in an intertonguing relationship with the Green River Formation. It was deposited as thick, regionally extensive stratigraphic sequences primarily in an alluvial-fluvial environment peripheral to the ancestral lakes. Depths to the top of the formation range from 3,147 to 10,754 feet (FIGURE UO-9).

Most of the production comes from lenticular fluvial-alluvial channel and alluvial overbank sandstone deposits. The productive sandstones are usually isolated and encased in siltstones, mudstones, and shales (Figure UO-10). Porosity and permeability are generally reduced by diagenesis, so production is enhanced near or along major fault and fracture zones. The average porosity ranges from 5 to 20 percent, and the permeability is 0.1 mD or lower.

The source rocks for oil and associated gas found in the Wasatch Formation are organic-rich carbonate mudstones of the Green River Formation, and are located at a depth of 8,500 to 12,500 feet in the north-central part of the basin. Source rocks for the non-associated gas are organic-rich siltstones and mudstones, carbonate shales, and coals of the Mesaverde Group, located at depths of 6,000 feet or greater.

There are more than 60 known reservoirs, 5 of which have produced at least 5 BCFG (Figure UO-6). The first reservoir to produce from the Wasatch Formation was Peters Point in 1953. The total monthly gas production increased between 1973 and 1982, and has been fairly constant since then (Chidsey, 1993c).

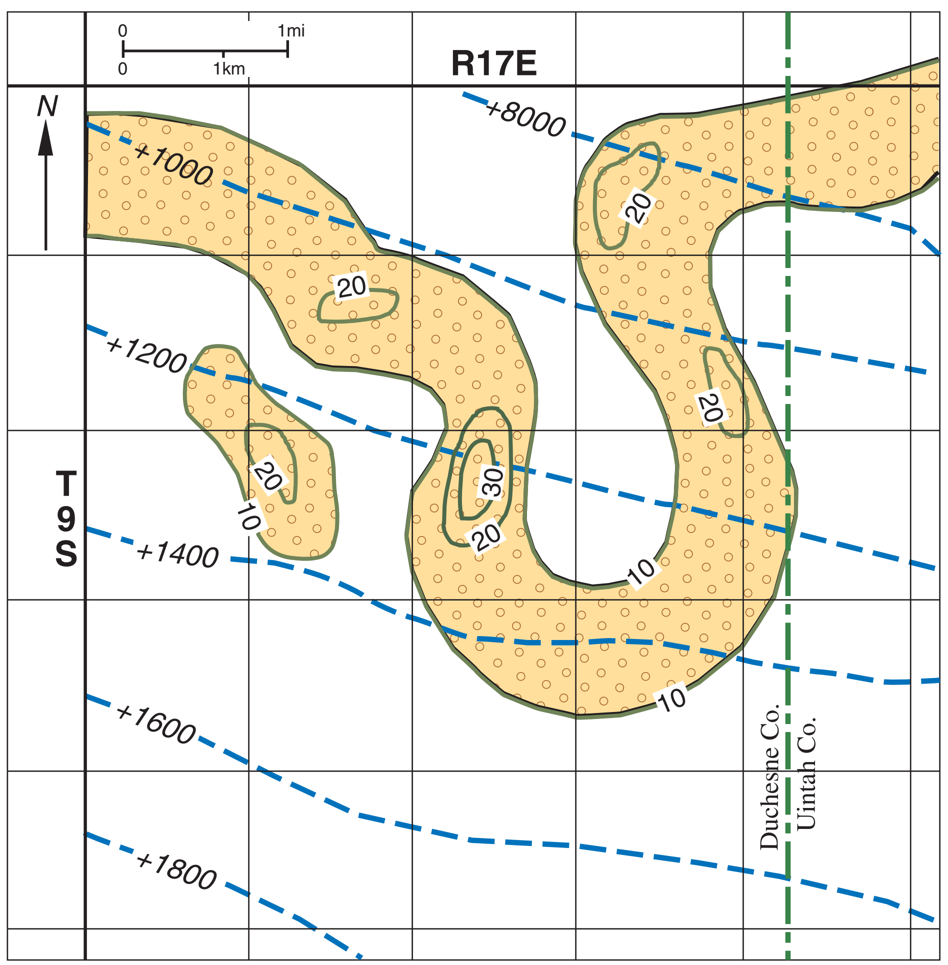


Figure UO-8. Structure contour map with isopach of single sandstone bed, Monument Butte reservoir, Duchesne and Uinta Counties, Utah. Structure contours (dashed lines with contour interval of 200 ft.) are based on a datum approximately 150 ft. below the middle marker of the Green River Formation and show no structural closure. Net sandstone isopachs (solid lines with contour interval of 10 ft.) are based on one of many individual productive sandstone units encased by shale or mudstone. Isopach geometry indicates deposition of sandstone by meandering streams. The trap is created by updip pinch-out of channel sandstone to south along regional strike (modified after Chidsey, 1993b).

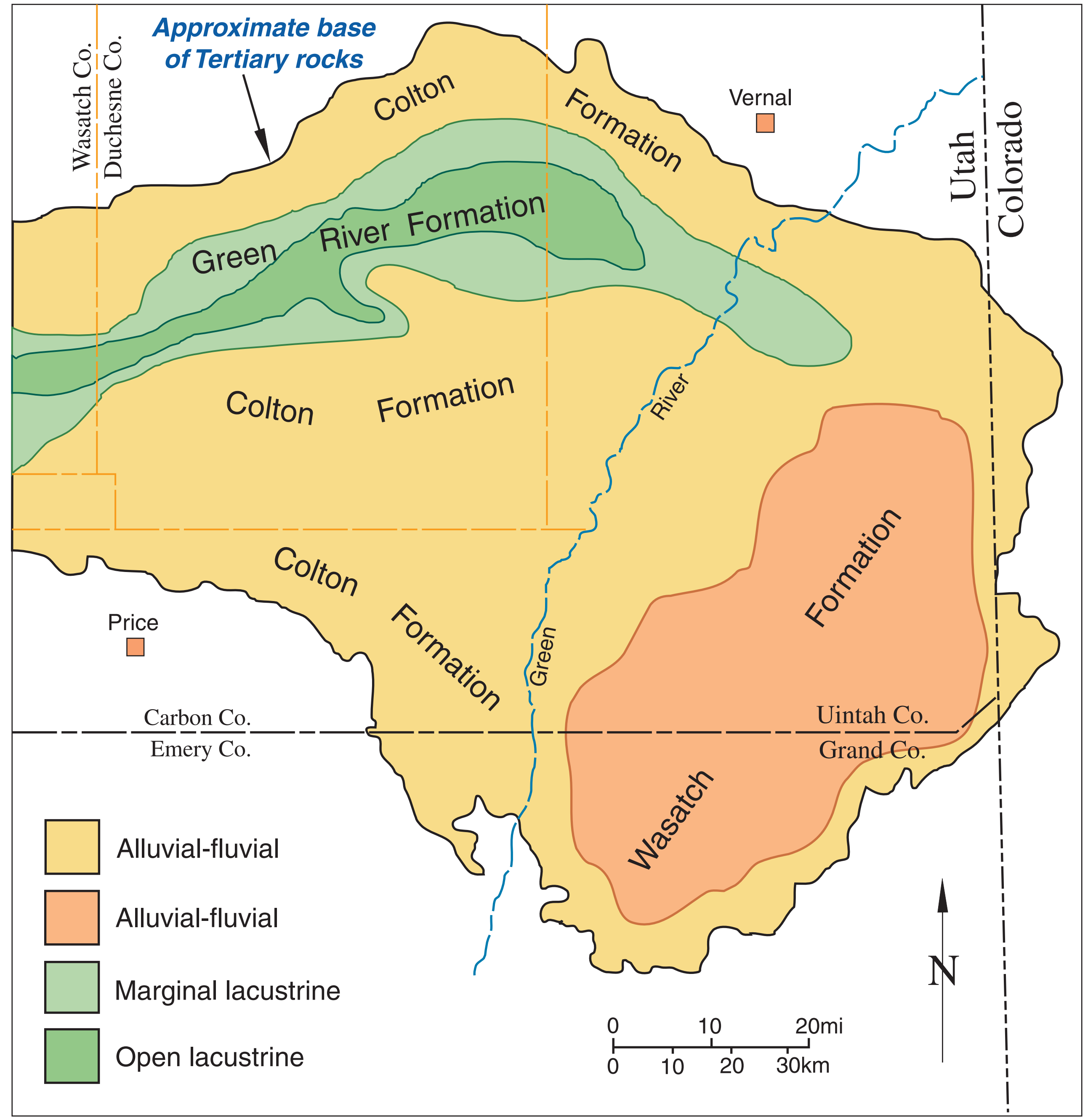


Figure UO-9. Major depositional facies and distribution of formations at the Paleocene-Eocene boundary. Note widespread Wasatch-Colton deposition in the Uinta Basin (modified after Chidsey, 1993).

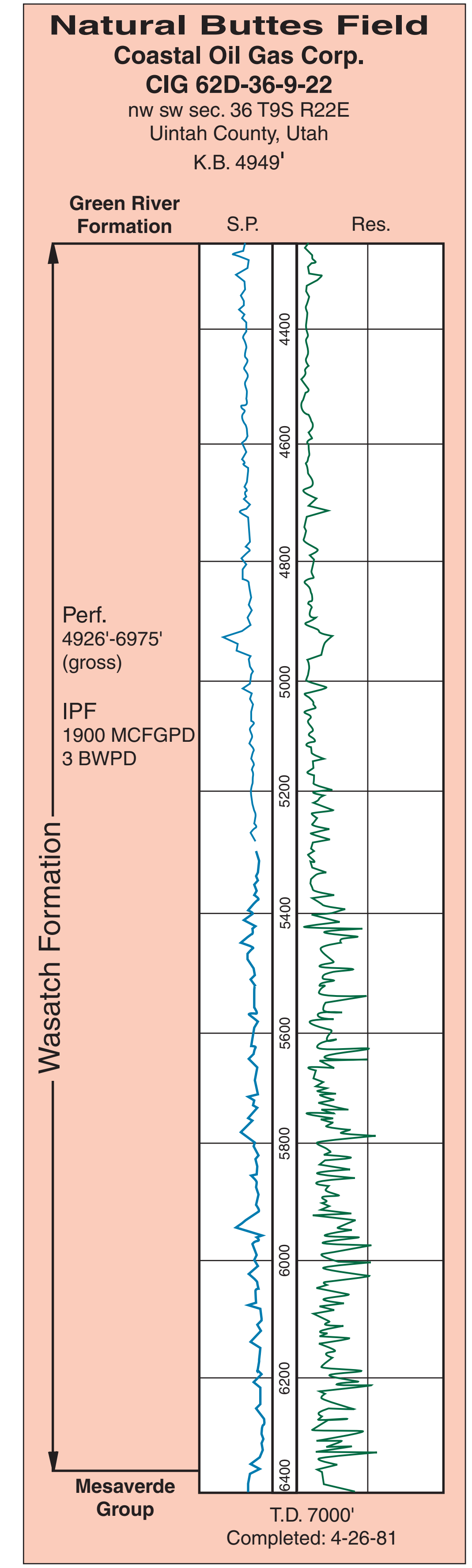


Figure UO-10. Typical SP-resistivity log of the Natural Buttes Wasatch reservoir, Uintah County, Utah (modified after Chidsey, 1993c).